“ IN SEARCH FOR WATER”

PROYECT GLOBE. IES VEGA SAN MATEO.
GRAN CANARIA. SPAIN.

2.016

Water in Gran Canaria is a rare good. For several years now, we have opted for the production of industrial waters (desalinated and regenerated), to satisfy the needs of both the humane consume in big urban areas and the tourist sector; as well as in its use for intensive exportation agriculture

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IN SEARCH FOR WATER

SUMMARY

Water in Gran Canaria is a rare good. For several years now, we have opted for the production of industrial waters (desalinated and regenerated), to satisfy the needs of both the humane consume in big urban areas and the tourist sector; as well as in its use for intensive exportation agriculture (banana and tomato.) However, due to the poor acceptance that this kind of water has among the consumers, there is a great competition between the areas that produce water and those that don't. This competition translates into a competition for quality, price and the supply, which directly affects the agriculture of the area.

In this work, we want to analyze and interpret the agronomical quality of the different sources of water and we also want to prove that they can be used in the areas with more demand without the need to transfer water or to compete with local water; avoiding, therefore, unfair competition between regional farmers and big inshore consumers.

REPORT

Gran Canaria island can undoubtedly be considered a miniature continent for its incredible variety of natural environments. This island is 47 km wide and has a total area of 1532 square kilometres.

The African continent is just 197 kilometers away. The archipelago, because of its placement, should have a dry and warm climate, but nevertheless factors as insularity and relief provoke harsh contrasts in precipitation and also very low temperatures.

Gran Canaria has an average pluviometry of 300mm per year. But if this rain is already rare, less than a 25% is profited, because the evapotranspiration is high, and the slope of the ravines is steep, little water can be retained.

According to the United Nations, for a land to have minimum coordinates of foodstuff, it must produce at least 50% of what it consumes, and in the Canary Islands we produce less than a 14 %.

The economy in the Canarian Islands was dominated by agriculture until the 60's, but the strong development of the tourist industry has meant a loss of importance for this sector in the whole area, being thus determining in the island of Gran Canaria.

Gran Canaria has two very different kinds of agriculture. On the one hand, exportation agriculture of vegetables and banana mainly, which occupy the lowest areas of the island. And on the other hand, agriculture for the inner consume, which is widely

spread throughout all the territory in small exploitations, and is therefore much more rural.

The gross total demand from the agricultural sector is 66.9 hm^3/year.

One of the main issues of the rural world and the environment is, precisely, its neglect.

Not only do agricultural activities disappear, but also this loss affects the inhabitants of these areas, pushed to move to the cities or the tourist areas with more possibilities. This provokes numerous changes and problems for the environment.

In Gran Canaria, the tourist sector generates a demand of 16.3hm^3 that is evenly distributed throughout the year, and as regards space it is mainly concentrated in the tourist areas. These quantities must be considered regarding the increase of residual water to be treated and it rivals in quality, quantity and price with the farmers, not only for the tourists themselves but also you have to add the exponential comsuption of the golf courses, the theme parks and the areas of beautiful parks and gardens . (Consejo Insular de Aguas de Gran Canaria, 2007).

During the execution of this job, we have checked the different, the most reliable and modernized sources was the one publicated by Consejo Insular de Aguas de Gran Canaria, which, although it is from the year 2007, it collects the demands according to the use and percentaje that represents.

Here we can see a chart with the different origins of the water in Gran Canaria.

Table 1: Consumption and use of different sources of water in Gran Canaria.

2007	Agrario	Recreativo	Urbano	Turistico	Industrial	Total
Subterránea	47,7	2,0	14,6	3,8	3,3	**71,4**
Superficial	8,0	0,8	1,7	0,5		**11,0**
Desalada	11,0	0,9	43,9	12,0	5,0	**72,8**
Regenerada	3,8	8,0				**11,8**
Total	**70,5**	**11,7**	**60,2**	**16,3**	**8,3**	**167,0**

%	Agrario	Recreativo	Urbano	Turistico	Industrial	Total hm^3
Subterránea	66,8%	2,8%	20,5%	5,3%	4,6%	**71,4**
Superficial	72,7%	7,3%	15,5%	4,5%		**11,0**
Desalada	15,1%	1,2%	60,3%	16,5%	6,9%	**72,8**
Regenerada	32,2%	67,8%				**11,8**

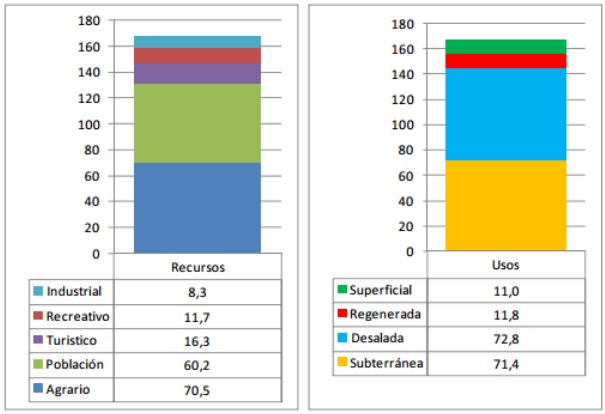
Source: Consejo Insular de Aguas de Gran Canaria, 2007

As a result of the previous chart, we can notice that the total consume and demand in Gran Canaria is almost 167 hm^3 a year and this is the main demand of the population, which represents nearly a 46% of the total demand and it can be divided

into an urban constant population, with 60,2 hm^3 a year, and touristic demand, with 16.3 hm^3 a year.

The agricultural demand is about 70,5 hm^3 a year, which represents 42%,as well as, the recreational demand with almost 11,7hm^3/ year (7%) ,and for the industrial demand that do not depend on the urban supply with 8,3hm^3/year (5%).

Figure 1: Resourses and uses of the different water sources in Gran Canaria.



Source : Consejo Insular de Aguas de Gran Canaria, 2007

In the previous chart ,we can see that the 43% of the total demands in Gran Canaria are satisfied with desalinated water. The sea desalinated water provides the 73% of the total urban and tourist supply, proving the importance of this water in the island.

For the reasons above,and as the IES Vega de San Mateo is located in a mainly agricultural area, in our High School we have studied the different water sources our municipality has and analize its quality as well as its use in the different cultivation of the village.

The groups of students and teachers who have participated in this project are in the appendix.

2.1 Farming and Weather data

For the treatment of the data ,we have used the metereological data taken in the station located at IES Vega de San Mateo during this school year. The rest of the data have been checked in a nearby station which belongs to the Canarian government, Agricultural Department (Latitude : 28º 01 16” N; Longitude 15º 31 54” W; Height , 785m)

Picture 1: Weather station Canarian Government

The ETO calculation has been got directly from the provided data by the station mentioned previously. The Pemman-Monteith method has been used.

2.1.1 Analisys and interpretation of the farming and weather data.

Figure 2: Precipitation and average temperatures

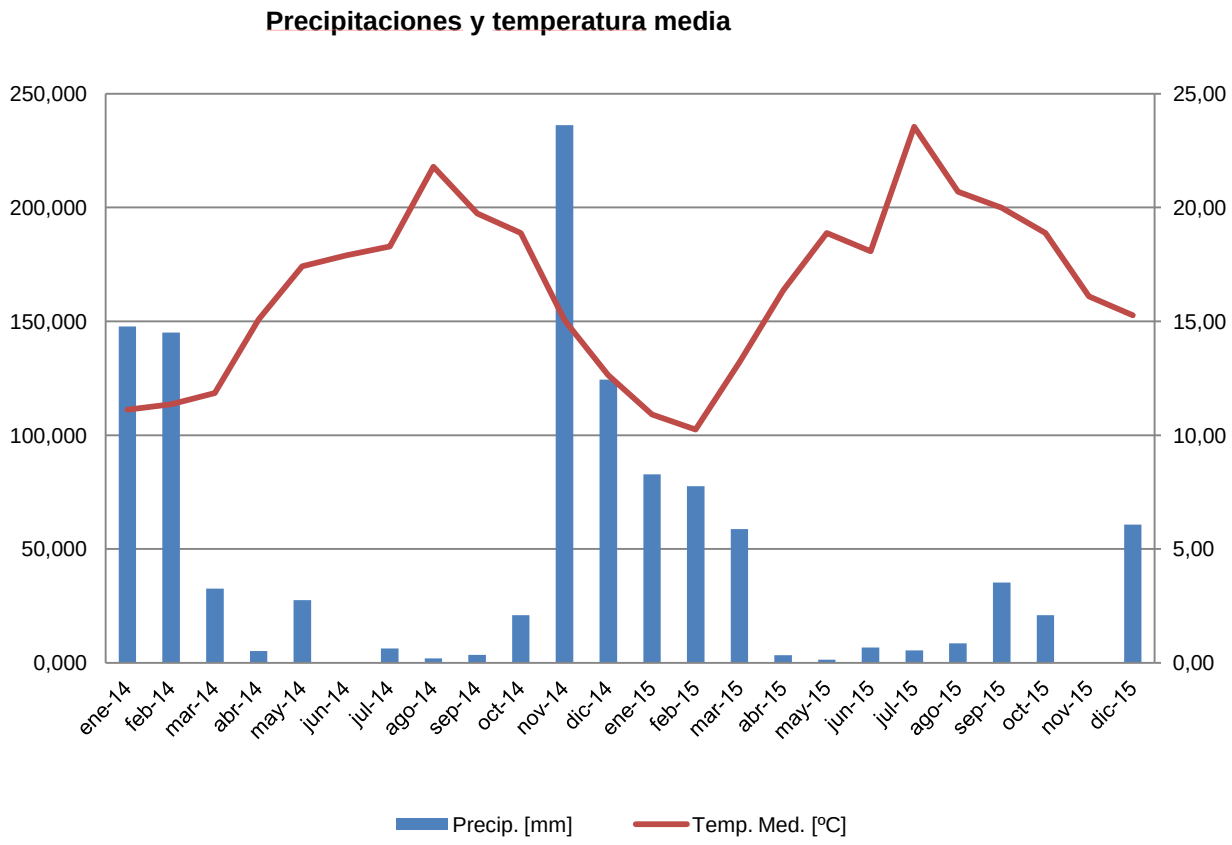


Figure 3: Temperatures highest, lowest, average (ºC)

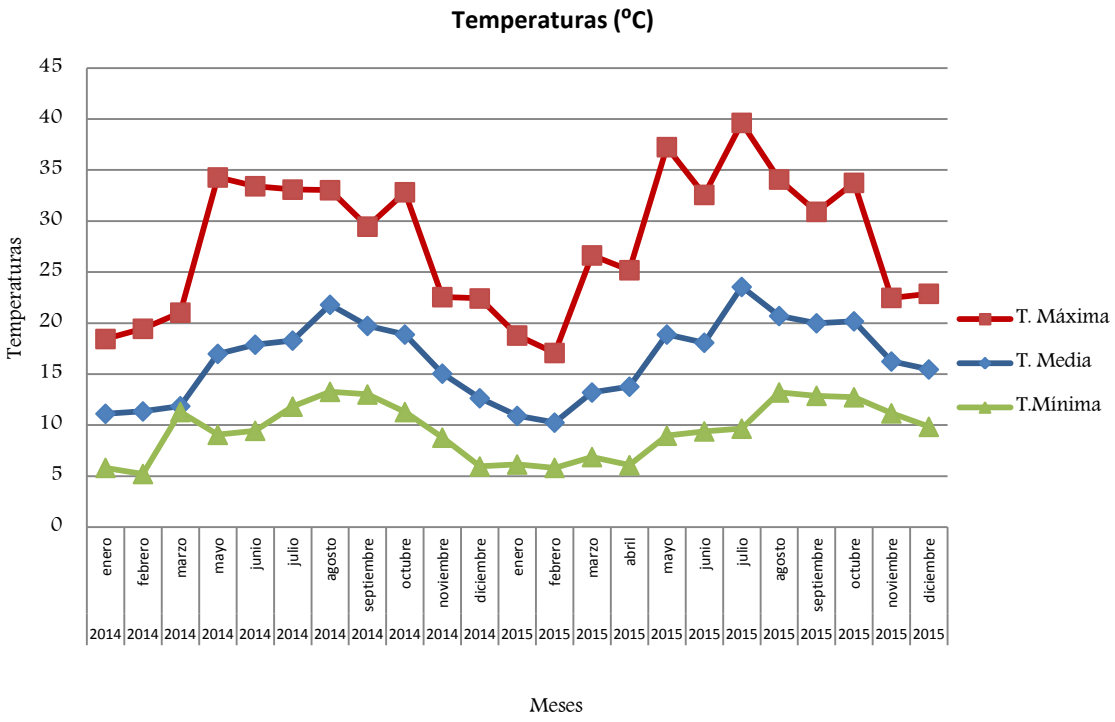
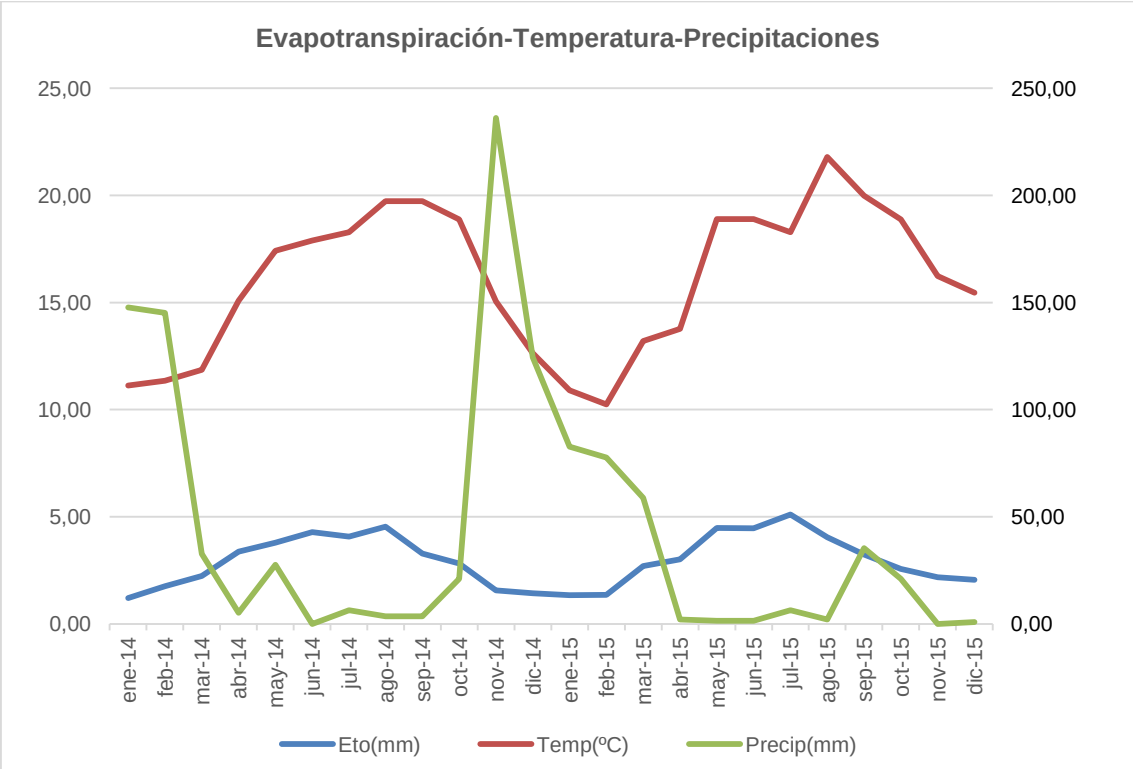


Figure 4: Evapotranspiration(mm/day) – Average Temperature(ºC)-Precipitations(mm)



2.2 Water form natural sources

2.2.1 Spring water

2.2.1.1. Characteristics, precedence and location

It is hard to make an estimation of the superficial origin, as they are captured through a complex system of dams, intakes and pipings that cover all the island, but it could be estimated in 8hm^3. It has a high interest form the agricultural point of view, but it is very located. In many cases, these sources are linked to small owners, with reservoirs that store and regulate the flow for its ulterior use in irrigation. This water is discontinuous as its flow is not constant, as it depends on yearly pluviometry and, in many cases, this sources disappear during the Summer season.

The sample taken has the following coordinates: latitude: 27º59´50.24" N, longitude: 15º37´10.01" W y and the spot is known as La Tosca (Fuente Sequia).

Picture 2: Spring Water La Tosca (Fuente Sequia).

Source: Students High School.

2.2.1.2. Analysis

The analysis of the different waters has been done in the school laboratory, except for the content of sodium (Na), which was determined at the University of Las Palmas Laboratory, Chemistry Department.

Picture 3 University of Las Palmas de Gran Canaria. Chemistry Department.

Picture 4: Students in the Laboratory

Table 2: Analytical results to Spring water La Tosca (Fuente Sequia).

Parámetro	
pH	7.7
C.E. (25 ºC) dS/m	0.130
TSD (gr/l)	0.0832
π_o (atm)	0.046
Elemento	meq/l
Calcio (Ca^{++})	0.4
Magnesio (Mg^{++})	0.4
Sodio (Na^{+})	0.11
Carbonato (CO_3^{--})	0
Bicarbonato (HCO_3^{-})	0.15

2.2.1.3. Agronomic interpretation

Table 3: Agronomics interpretation results to Spring water la Tosca (Fuente Sequia).

Parámetro	
pH	Alkaline
C.E. (25 ºC) dS/m	Very Low
SAR	0.17
PSI	12.08%
Relación de Calcio (Indice de Kelly)	43.95 %
CSR (Indice de Eaton)	0.65
Dureza (ºF)	0.26
Indices combinados	
Norma Riverside	C_1S_1
Norma Wilcox	Excellent

2.2.2. Gallery water

2.2.2.1. Characteristics, procedence and location.

A gallery is a tunnel with only one way in, drilled with the aim of getting water. Achieving this objective depends on multiple factors as, its location, length, materials and position of the stratum, among others.

By the end of the XIXth century, galleries began to be drilled wherever the existence of underground water was more evident; that is to say, in areas where there were already natural springs. It is a highly appreciated water for farmers, but it has the problem of regulating its flow in times when it is not used; as for example, during rainy periods of time. During the last years the flow of water has seen a marked decrease.

The sample taken has the following coordinates: Latitude: 27º49´47.75" N, longitude: 15º32´26.17" W and the spot is known as Finca EL Calero.

Picture 5: Gallery water El Calero.

Source: Students to High School.

2.2.2.2. Analysis

Table 4: Analytical results to Gallery water El Calero.

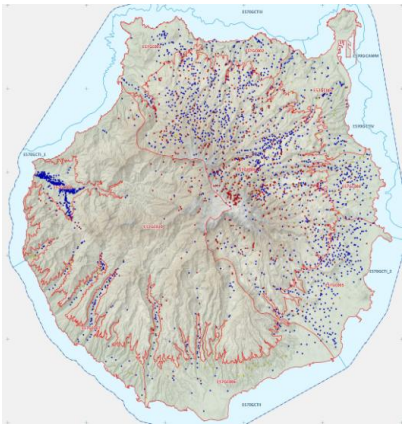
Parámetro	
pH	7.6
C.E. (25 ºC) dS/m	0.220
TSD (gr/l)	0.078
π_o (atm)	0.079
Elemento	meq/l
Calcio (Ca^{++})	2.005
Magnesio (Mg^{++})	2.59
Sodio (Na^{+})	0.95
Carbonato (CO_3^{--})	0
Bicarbonato (HCO_3^{-})	2.68

2.2.2.3. Agronomic Interpretation.

Table 5: Agronomics interpretation results to Gallery water El Calero.

Parámetro	
pH	Alkaline
C.E. (25 ºC) dS/m	Very Low
SAR	0.62
PSI	17.13 %
Relación de Calcio (Indice de Kelly)	36.15 %
CSR (Indice de Eaton)	-1.91
Dureza (ºF)	1.58
Indices combinados	
Norma Riverside	C_1S_1
Norma Wilcox	Excellent

Figure 5: Location of wells and galleries registered in Gran Canaria



Source: Consejo Insular de Aguas de Gran Canaria, 2.007

2.2.3. Well water

2.2.3.1. Characteristics, procedence and location.

As for wells, their use is more delicate than that of the dams, given that on being used, the aquifer will drain out. Gran Canaria has utilized almost half of its water reserve within the last twenty years. With this overexploitation, not only do aquifer levels descend, but also the quality of the waters diminish, as they see their salinity increase. Even though there are over 2000 wells, the number of those which are being exploited is unknown, neither is it known the volume of water extracted. In the area, subject of this research, there are wells of more than 300m deep.

The sample taken has the following coordinates: Latitude: 27º59´15.99” N, longitude: 15º32´03.66” W and the spot is known as Finca EL Montañón.

Picture 6: Pozo El Montañón.

Sources: Students to High School.

Picture 7: Well Water and operator to Pozo El Montañón.

Sources: Students to High School.

2.2.3.2. Analysis

Table 6: Analytical results to Pozo del Montañón.

Parámetro	
pH	8
C.E. (25 ºC) dS/m	0.190
TSD (gr/l)	0.1216
π_o (atm)	0.0684
Elemento	meq/l
Calcio (Ca^{++})	0.22
Magnesio (Mg^{++})	0.36
Sodio (Na^{+})	0.15
Carbonato (CO_3^{--})	0
Bicarbonato (HCO_3^{-})	1.30

2.2.3.3. Agronomic Interpretation

Table 7:Agronomics interpretation results to Pozo del Montañón.

Parámetro	
pH	Alkaline
C.E. (25 ºC) dS/m	Very low
SAR	0.27
PSI	20.54 %
Relación de Calcio (Indice de Kelly)	30.13 %
CSR (Indice de Eaton)	0.72
Dureza (ºF)	0.2
Indices combinados	
Norma Riverside	C_1S_1
Norma Wilcox	Excellent

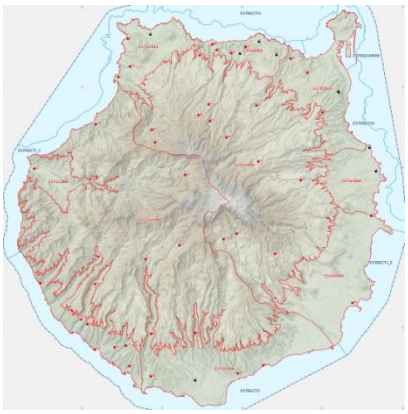
2.3. Water of industrial origin.

2.3.1. Regenerated water

2.3.1.1. Characteristics

As for waste waters, Gran Canaria is also a pioneer in reusing them for farming. Depurated water is a supplementary source that will help balance the island hydrological equilibrium. It can warranty the irrigation of the crops in times of need. On the other hand, it adds a supplement of nutrients that makes production more competitive. However, according to works cited, it isn't being used either for farming nor for green areas in the San Mateo municipality; instead, It is directly being spilled into the ravine.

Figure 6: Location of water tratament plants in Gran Canaria



Source: Consejo Insular de Aguas de Gran Canaria, 2.007

The sample taken has the following coordinates: Latitude: 28º00´37.58” N, longitude: 15º31´43.17” W and the spot is known as La Bodeguilla.

Picture 8: Water tratament plant La Bodeguilla.

Sources: Students to High School.

2.3.1.2. Analysis

Table 8 Analytical results regenerated water La Bodeguilla.

Parámetro	
pH	7.4
C.E. (25 ºC) dS/m	1.2
TSD (gr/l)	0.768
π_o (atm)	0.432
Elemento	meq/l
Calcio (Ca^{++})	0.92
Magnesio (Mg^{++})	1.74
Sodio (Na^{+})	1.32
Carbonato (CO_3^{--})	0
Bicarbonato (HCO_3^{-})	2.29

2.3.1.3. Agronomic Interpretation

Table 9 Agronomics interpretation results to regenerated water La Bodeguilla.

Parámetro	
pH	Alkaline
C.E. (25 ºC) dS/m	High
SAR	1.14
PSI	33.16 %
Relación de Calcio (Indice de Kelly)	23.11 %
CSR (Indice de Eaton)	-0.37
Dureza (ºF)	0.96
Indices combinados	
Norma Riverside	C_3S_1
Norma Wilcox	Good

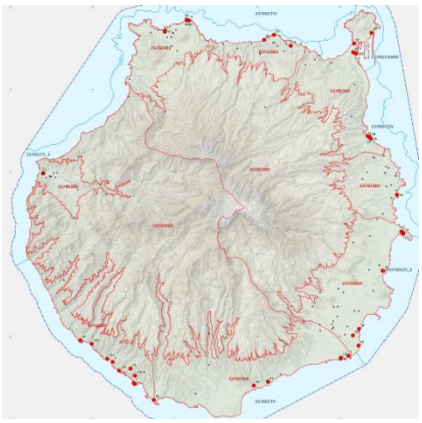
2.3.2. Desalinated water

2.3.2.1. Characteristics, origin and location

The desalination of sea water has become an alternative of the future not only for Gran Canaria, but also for the rest of Spain. The Canary islands is a pioneering region in this aspect, as the first desalination plant was built in Lanzarote back in 1964.

Gran Canaria has bet on the functioning of the desalination plants for farming use for close to a decade so far. This has proved to work well. There are 42 desalination plants, with a present capacity of 62hm^3. The main system used is inverse osmosis.

Figure 7: Location of desalinated water in Gran Canaria



Sources: Consejo Insular de Aguas de Gran Canaria, 2.007

The sample taken has the following coordinates: Latitude: 28º02´31.65" N, longitude: 15º24´39.52" W and the spot is known as Jinámar

Picture 9: Desalinated water to Jinámar

Sources: Students to High School.

2.3.2.2. Analysis

Table 10: Analytical results de desalinated water to Jinámar.

Parámetro	
pH	7.5
C.E. (25 ºC) dS/m	0.9
TSD (gr/l)	0.576
π_o (atm)	0.324
Elemento	meq/l
Calcio (Ca^{++})	0.26
Magnesio (Mg^{++})	0.38
Sodio (Na^{+})	1.5
Carbonato (CO_3^{--})	0
Bicarbonato (HCO_3^{-})	0.37

2.3.2.3. Agronomic Interpretation

Table 11: Agronomics interpretation results to desalinated water Jinámar.

Parámetro	
pH	Alkaline
C.E. (25 ºC) dS/m	High
SAR	2.6
PSI	70%
Relación de Calcio (Indice de Kelly)	12.15 %
CSR (Indice de Eaton)	-0.27
Dureza (ºF)	0.22
Indices combinados	
Norma Riverside	C_3S_1
Norma Wilcox	doubtful

CONCLUSIONS

1. According to the climatological analysis shows that it takes irrigate crops in our region for much of the year.
2. The quality of our waters are excellent.
3. The water treatment plant could be used at low levels for gardens and street cleaning.
4. The water desalination plant needs to be improved if it is to be used for irrigation.
5. The desalinated water can be used in tourist areas

WE'D LIKE TO THANK

From the High School (GLOBE project) we want to thank the University of Las Palmas by allowing us to use their laboratories for high school students could determine some elements, also the composer Don Ernesto Mateo for sharing with us the rights of their theme song "Rain around "for editing the video.

Thank all the teachers who collaborated on the project and the very special form to the students.

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APPENDIX

Appendix 1

Teachers and Composer.

Ms Cristina Mahugo …… ……..Physics and Chemistry Department.

Mr Ricardo Ojeda…… Physics and Chemistry Department.

Ms Inmaculada Hernández…….. Mathematics Department.

Ms Dolores García…….English Department.

Mr José Juan Pérez……..Forest Departament (Coordinator)

Ms Ivonne Rodríguez…….. Technologic Departament

Ms Alodia Fleitas……..Music Departament

Mr Ernesto Mateo…….Music Composer

Appendix 2

Students:

The weather date: 4ºESO (Grade 10 th)

Déniz Déniz, Kilenia
Déniz Santana, Manuel
González Suárez, Antonio
Herrera Sosa, Yaiza
Jiménez Quintana, Anella
Miranda Pulido, Sara
Montesdeoca Bolaños, Samuel
Naranjo González, Siara
Ojeda Valido, Marcos
Quintana González, Alberto
Reyes Ortega, Laura
Rivero Socorro, Misael
Robaina Reina, Idaira
Rodríguez Ventura, Ylenia
Sánchez Gutiérrez, Julián
Santana Alonso Juan, Ramón

Analitics and traducction: 2º Bachillerato (12 th)

Alonso Hernández, Erik
Alvarez Alamo, Claudio
Barreto Molina, Carlos
Batista Santana, Néstor
Gil Bordón, Gabriel
Gil Déniz, Marta
Marrero González, Daniel
Ramírez Muñoz, Iria
Reina Santana, Chiristian
Rodríguez Galván, Eduardo
Rodríguez Ponce, Vanessa
Santana Cabrera, Aitor
Santana Miranda, Gonzalo
Santana Rosales, Alvaro
Suárez Santana, Natalia
Torres Clarke, Jeffrey
Valido Sánchez, Samuel
Vega Rodríguez, Raul
Ventura Sosa, David

Agronomics Interpretation : (1º Technical Forest)

Bentancor Santana, Cristian
Cabrera Bouffault, Mario
Camejo Santana, Saul

Hernández Morales, Antonio
Herrera Ruiz, Juan Manuel
Jorge Santana, Oscar
Mayor Mayor, Tamara
Nantón San Martín, Germán
Nuez Morales, Mario
Ortega Martínez, Alberto
Perdomo Suárez, Cristhian
Pérez Martín, Angel de Jesús
Quintana García, José Alberto
Quintana Peñate, Carlos
Rebull Santana, Jonathan
Reyes Sánchez, José
Rodríguez Ojeda, Roberto
Santana Montesdeoca, Airam
Sarmiento Huertas, Alejandro
Sarmiento Huertas, José
Suárez Tacoronte, Aitami

Edition and audio: 4º ESO (Grade 10 th)

Alfonso Dávila, María del Carmen
Alvaro De Armas, Viera
Déniz Nuez, Keyla
Déniz Vera, Pablo
Domínguez González, Jacob
Fleitas Lorenzo, Alba Del Rosario
Galván Ortiz, Elena
Hernández Suárez, Idafe
Martel Marrero, Pablo
Montesdeoca Santana, Pablo
Miranda Santana, Alexis
Monzón Vizcaíno, Lucía
Ortiz Pérez, Rita
Pando Monzón, María del Carmen
Pérez Almeida, David
Rodríguez Monzón, Carla
Rodríguez Santana Alvaro
Santana Merino, Beatriz
Santana Pérez, Saulo
Santana Ramírez, Amanda
Suárez Rivero, David
Ventura Perdomo, Santiago

Appendix 3

Formula for Agronomic Interpretation

$$S.A.R = \frac{|Na|}{\sqrt{1/2 * (|Ca| + |Mg|)}}$$

TSD= C.E. x 0.64

Π_o= C.E. x 0,36

P.S.I. =[$(Na^+)/(Ca^{++} + Mg^{++} + Na^+)$] x 100

$$RSC = ([CO_3^{2-}] + [HCO_3^-]) - ([Ca^{2+}] + ([Mg^{2+}])$$

$$Dureza = \frac{(Ca \times 2{,}5) + (Mg \times 4.12)}{10}$$

Appendix 4

Grafics and Table for Agronomic Interpretation

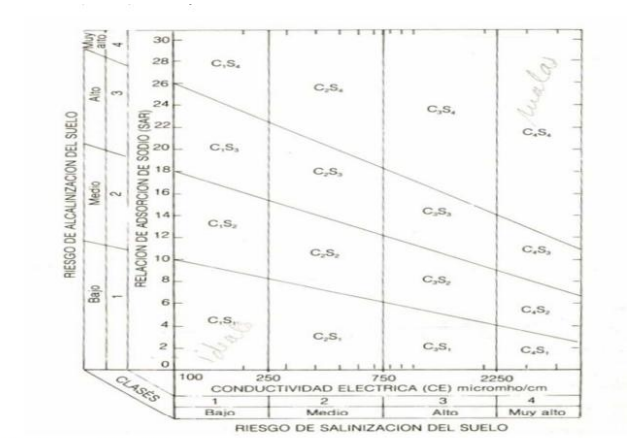

Figura: 63 ***"Diagrama para clasificar las aguas de riego según el U.S. Salinity Laboratory Staff (1954)".***

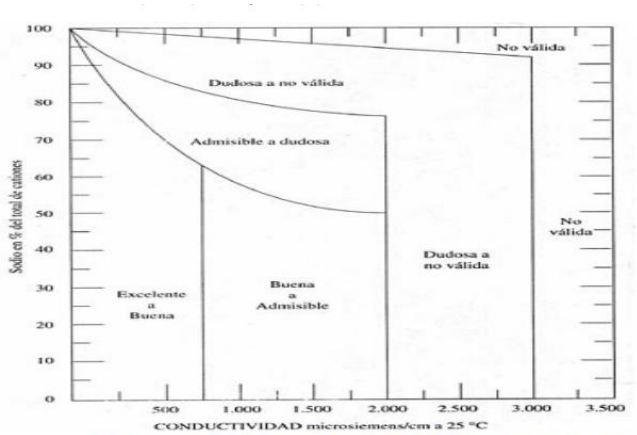

Figura: 64 ***"Diagrama para la interpretación del valor de un agua de riego. (Adaptado de "The Quality fo water for Irrigation USE", U.S.D.A)"***

Conductividad eléctrica		Contenido en sales disueltas
CE µS/cm	**Riesgo**	**mg/l ó ppm**
0-250	Bajo	160
250-750	Medio	160 - 480
750-2250	Alto	480 - 1440
más de 2250	Muy alto	mayor de 1440

Riesgo de sodio	
SAR	Riesgo
0 - 10	Bajo
10 - 18	Medio
18 - 26	Alto
más de 26	Muy Alto

Carbonato sódico residual		
RSC (meq / l)	Riesgo	
<0	Bajo	Recomendable
1,25 - 2,5	Medio	Poco recomendable
más de 2,5	Alto	No recomendable

Cuadro indicativo de valores de dureza	
Tipo de agua	Grados hidrométricos franceses
Muy blanda	Menos de 7
Blanda	7-14
Medianamente blanda	14-22
Medianamente dura	22-32
Dura	32-54
Muy dura	>54